

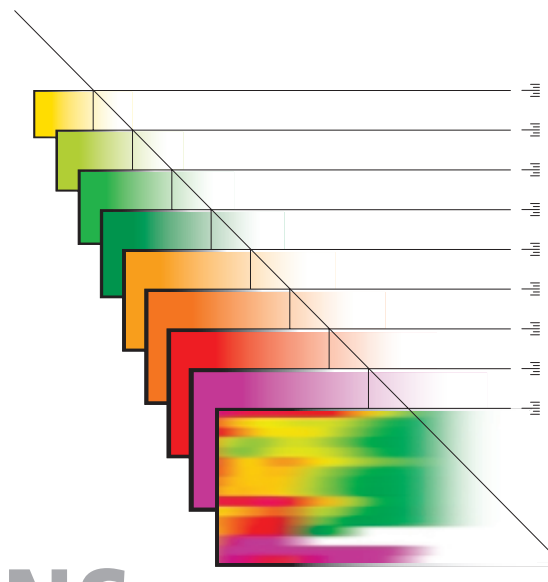
Measurements to Enhance Completion Placement and Effectiveness

APPLICATIONS

Engineering Challenge	Applied Measurement	Resulting Value
Depth Correlation <ul style="list-style-type: none"> Setting completion hardware Perforating on depth Compaction issues 	SpectraMark - Depth correlation casing PIP tags	<ul style="list-style-type: none"> Reliable depth correlation for setting hardware and perforating Determine casing deformation due to formation compaction
Zonal Coverage <ul style="list-style-type: none"> Single stage or stacked pack Large gross intervals 	SpectraStim / SpectraScan - Diagnostic tracer and imaging services	<ul style="list-style-type: none"> Optimize number of stages for effective completion Determine zonal coverage • Identify unstimulated pay
Fluid System Selection <ul style="list-style-type: none"> Compatibility with reservoir Clean up efficiency Proppant transport 	SpectraChem - Chemical tracer services Stim-Lab - Proppant and fluid laboratory testing	<ul style="list-style-type: none"> Minimize fluid damage to formation and proppant pack Maximize effective proppant pack conductivity • Maximize frac fluid recovery • Improve flowback techniques to maximize proppant conductivity
Annular Pack <ul style="list-style-type: none"> Quality of annular pack Amount of reserve on blank Voids or holidays in pack 	SpectraStim / SpectraScan - Diagnostic tracer and imaging services PackScan - Gamma density image	<ul style="list-style-type: none"> Determine top of sand in blank • Identify voids in annular pack Determine formation sand influx
Fracture Geometry <ul style="list-style-type: none"> Frac model calibration Fracture height determination Water zones and contacts Rock mechanics 	SpectraStim / SpectraScan - Diagnostic tracer and imaging services GOHFER - 3D fracture simulator Petroleum Services - Routine and special core analysis	<ul style="list-style-type: none"> Determine fracture height growth • Measure actual placement of frac pack • Determine early screenout of zones • Calibrate post-frac geometry • Design optimal frac program
Smart Well Equipment <ul style="list-style-type: none"> Proper sliding sleeve operation BH pressure and temperature 	SpectraChem - Early Production Test (EPT) wellsite diagnostic tracer services PROMORE - ERD permanent downhole pressure and temperature	<ul style="list-style-type: none"> Earliest positive indication that all sliding sleeves are shifted to correct production position • Reliable real-time pressure and temperature during all phases of completion • Optimize flowing draw-down across the screen • Obtain reservoir pressure over life of well
Production Evaluation <ul style="list-style-type: none"> Where is production coming from? Potential hot spots in screen What are the major gas/oil/water contribution zones? 	CompletionProfiler - Combination SpectraScan and full production evaluation tool	Evaluate zonal production • Determine potential hot spots on screen • Establish post-frac production index • Determine problem production zones • Determine major gas and oil production zones

Offshore completions in unconsolidated sand reservoirs are some of the most demanding and complex treatments faced by an operator. The extreme environments and high costs associated with these completions require high-quality stimulation and sand control for success.

ProTechnics has a diverse and unique set of completion diagnostic tools that provide offshore completion and production engineers with direct measurements of the completion placement and effectiveness. Patented washpipe deployment of our imaging services reduces the risk and cost of obtaining this vital diagnostic information.



MEASURED SOLUTIONS

THE COMPLETION DIAGNOSTICS COMPANY

ProTechnics

Service Description

ProTechnics provides a wide range of services and technology for completion diagnostics that optimize offshore completions, including:

Tracer Services

SpectraStim™ – Gamma emitting tracer service

SpectraChem™ – Chemical tracer service

SpectraMark® – Tracer marks for casing

Imaging Services

SpectraScan® – Memory spectral gamma ray image service

Completion Profiler® – Full service production evaluation imager; spinner, pressure/temperature, nuclear density and electrical capacitance

PackScan™ – Gamma density log

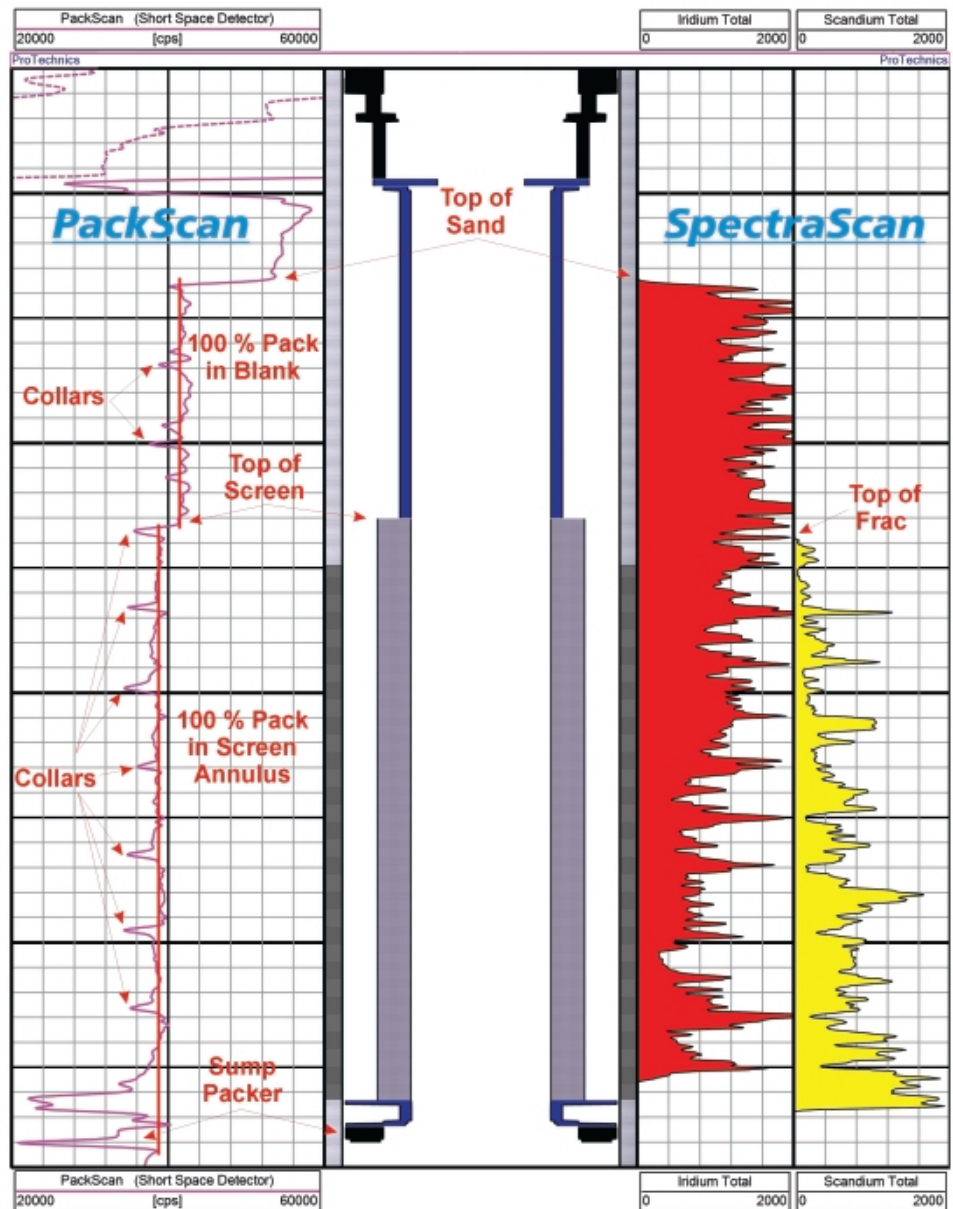
Other Services

Stim-Lab – Laboratory services for reservoir fluid compatibility testing, regained permeability testing, and fluid performance testing at fracture conditions

PROMORE – ERD sensor technology for permanent downhole pressure and temperature gauging systems

GOHFER® 3D-fracture simulator

Petroleum Services – Routine and special core analysis services, rock mechanics testing, sand onset, Poisson's ratio, Young's modulus



For more information, please visit our website at:

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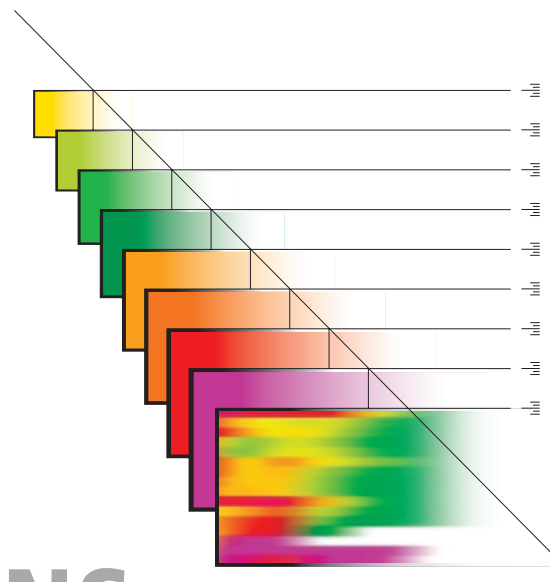
Measurements for Improved Sweep Efficiency

APPLICATIONS

Engineering Challenge	Applied Measurement	Resulting Value
EOR Feasibility <ul style="list-style-type: none"> Pilot project parameters Determine type of flood pattern Full-field parameters How much oil can be produced? 	SpectraFlood - Interwell tracer studies Stim-Lab - Compatibility studies (fluid-to-fluid, fluid-to-rock) Petroleum Services - Detailed core analysis, core flood studies	<ul style="list-style-type: none"> Optimize EOR project with better understanding of parameters Better knowledge of flood pattern configuration and efficiency Understand issues regarding potential formation damage
Injection Fluid Compatibility <ul style="list-style-type: none"> What type of fluid to inject for maximum recovery Fluid compatibility with reservoir 	Stim-Lab - Compatibility studies, (fluid-to-fluid, fluid-to-rock)	<ul style="list-style-type: none"> Optimize injection fluid compatibility with reservoir Maximize recovery factor
Reservoir Sweep Effectiveness <ul style="list-style-type: none"> Directional flow paths Reservoir heterogeneity Sweep patterns and efficiency Early breakthrough sources or paths 	SpectraFlood - Interwell tracer studies	<ul style="list-style-type: none"> Determine direct communication between injectors and producers Determine compartmentalization Increase flood recovery by maximizing flood effectiveness
Operational Efficiency <ul style="list-style-type: none"> High permeability systems and their fractional volume Direct flow paths or fractures Water cycling 	SpectraFlood - Interwell tracer studies PROMORE - ERD permanent downhole pressure and temperature	<ul style="list-style-type: none"> Determine type of water cycling Determine fractional volume of high permeability systems Reduce operating costs by reducing water cycling Compare simulated reservoir models to actual measured pressure data
Conformance Control <ul style="list-style-type: none"> Need for conformance control Conformance control design parameters Post-treatment evaluation 	SpectraStim / SpectraScan - Diagnostic tracer and imaging services SpectraFlood - Interwell tracer studies	<ul style="list-style-type: none"> Appropriate conformance treatment design Determine conformance treatment effectiveness Measure post-treatment efficiency

The reservoir and production engineers who manage Enhanced Oil Recovery (EOR) projects are constantly challenged to understand project effectiveness on a field-wide scale. ProTechnics **SpectraFlood™** interwell tracer technologies provide measurements of sweep efficiency to help optimize EOR performance.

ProTechnics has designed and executed interwell EOR studies around the globe and in all major U.S. basins. Economical interference studies provide a quick look at well-to-well pressure connectivity; interwell tracer studies examine direct connectivity between wells and pattern sweep efficiency.



MEASURED SOLUTIONS

Service Description

ProTechnics **SpectraFlood™** technology and an experienced staff of reservoir engineers and chemists offer a wide range of services to optimize EOR projects, including:

- Engineered designs using black oil reservoir simulation
- A versatile array of tracers
 - Radioactive
 - Chemical
 - Gas phase
- Accurate and reliable tracer injection
 - High pressure injection
- Advanced wet lab capabilities
 - Gas chromatography
 - Mass spectrometry
 - Liquid scintillation
- Engineered final report

Tracer Services

SpectraStim™ – Gamma emitting tracer service

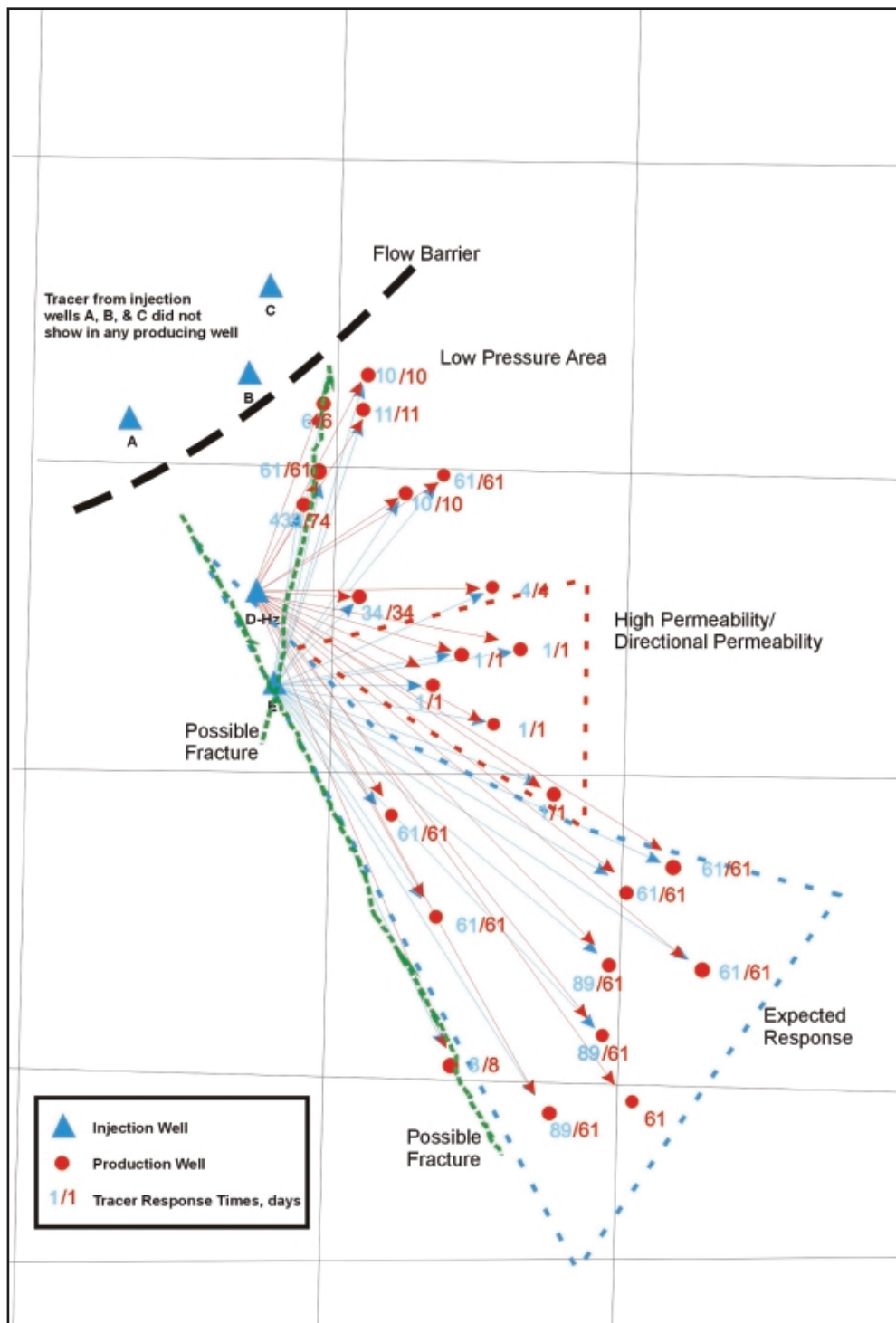
SpectraScan® – Memory spectral gamma ray image service

Other Services

Stim-Lab – Laboratory services for compatibility studies (fluid-to-fluid and rock-to-rock)

PROMORE – ERD sensor technology for permanent downhole pressure and temperature gauging systems

Petroleum Services – Routine and special core analysis services



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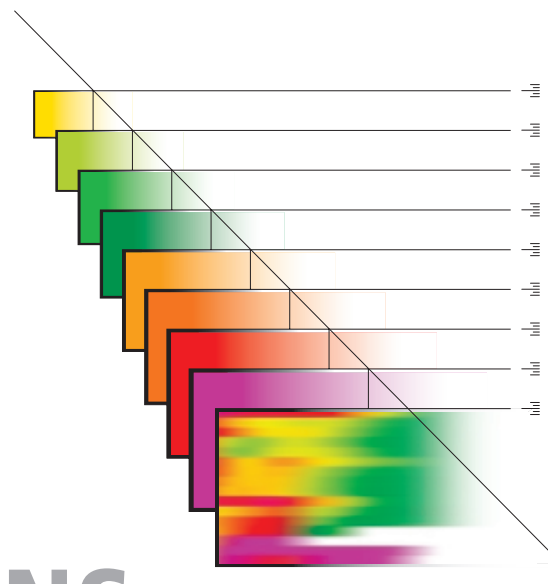
Measurements to Optimize Stimulation Treatments

APPLICATIONS

Engineering Challenge	Applied Measurement	Resulting Value
Perforation Strategy <ul style="list-style-type: none"> Limited entry perforating Multiple interval perforating Single source perforating Perforation quality 	SpectraStim / SpectraScan - Diagnostic tracer and imaging services	<ul style="list-style-type: none"> Determine if all intervals and perforations accepted treatment Evaluate limited entry perforating performance
Zonal Coverage <ul style="list-style-type: none"> Single stage or multi-stage Staging efficiency Staging isolation techniques 	SpectraStim / SpectraScan - Diagnostic tracer and imaging services	<ul style="list-style-type: none"> Ensure all stages were treated effectively Optimize number of stages for effective completion Identify by-passed reserves Validate proper operation of isolation devices
Fluid System Selection <ul style="list-style-type: none"> Compatibility with reservoir Effective fracture length Frac fluid performance Frac fluid cleanup effectiveness 	Stim-Lab - Proppant and fluid laboratory testing SpectraChem - Chemical tracer services	<ul style="list-style-type: none"> Minimize fluid damage to formation and proppant pack Maximize effective proppant pack conductivity Maximize frac fluid recovery Improve flowback techniques to maximize proppant conductivity
Wellbore Connectivity <ul style="list-style-type: none"> Proppant placement and distribution at the wellbore Proppant flowback control Placement of tail-in proppants and materials 	SpectraStim / SpectraScan - Diagnostic tracer and imaging services SpectraScan time lapse - Compare different time frame images	<ul style="list-style-type: none"> Optimize tail-in proppant volumes Achieve effective proppant distribution at the wellbore Determine proppant flowback issues Identify over-displacement
Fracture Geometry <ul style="list-style-type: none"> Frac model calibration Fracture height containment Post-frac BH pressure analysis 	SpectraStim / SpectraScan - Diagnostic tracer and imaging services GOHFER - 3D fracture simulator PROMORE - ERD permanent downhole pressure and temperature	<ul style="list-style-type: none"> Realistic frac determination using measured BH frac pressure and temperature Determine fracture height growth Post-frac geometry determination Accurate BH pressure measurements for real-time frac monitoring
Mechanical Integrity <ul style="list-style-type: none"> Squeeze perf integrity Cement competency Casing/tubing integrity 	SpectraStim / SpectraScan - Diagnostic tracer and imaging services	<ul style="list-style-type: none"> Identify cement channels behind pipe Determine mechanical integrity Determine stage collar integrity Easily locate casing splits and collar leaks Determine squeeze perf integrity
Production Evaluation <ul style="list-style-type: none"> Where is production coming from? What zones are producing? What are major gas/oil/water contribution zones? 	Completion Profiler - Combination SpectraScan and full production evaluation tool	<ul style="list-style-type: none"> Evaluate zonal production Establish post-frac production index Determine problem production zones Determine major gas and oil producing zones

Completion diagnostics from ProTechnics are used by completion engineers to better understand and optimize stimulation treatments. These diagnostic measurements are made using an array of unique tracer injection and imaging services, including SpectraStim™ isotope tracers and SpectraChem™ chemical tracers, the SpectraScan® imager and the Completion Profiler® system.

Measurements made using these technologies are applied as part of an iterative completion diagnostics process to improve stimulation results. This process involves designing treatments with numerical simulators, such as GOHFER® 3D, and measuring actual surface and downhole parameters during and after the treatment. Using these direct measurements, the reservoir and fracture models are calibrated to better predict the stimulation effect and resulting production performance.



MEASURED SOLUTIONS

Service Description

ProTechnics provides a wide range of services and technology for completion diagnostics that optimize stimulation treatments, including:

Tracer Services

SpectraStim™ – Gamma emitting tracer service

SpectraChem™ – Chemical tracer services

Imaging Services

SpectraScan™ – Memory spectral gamma ray image service

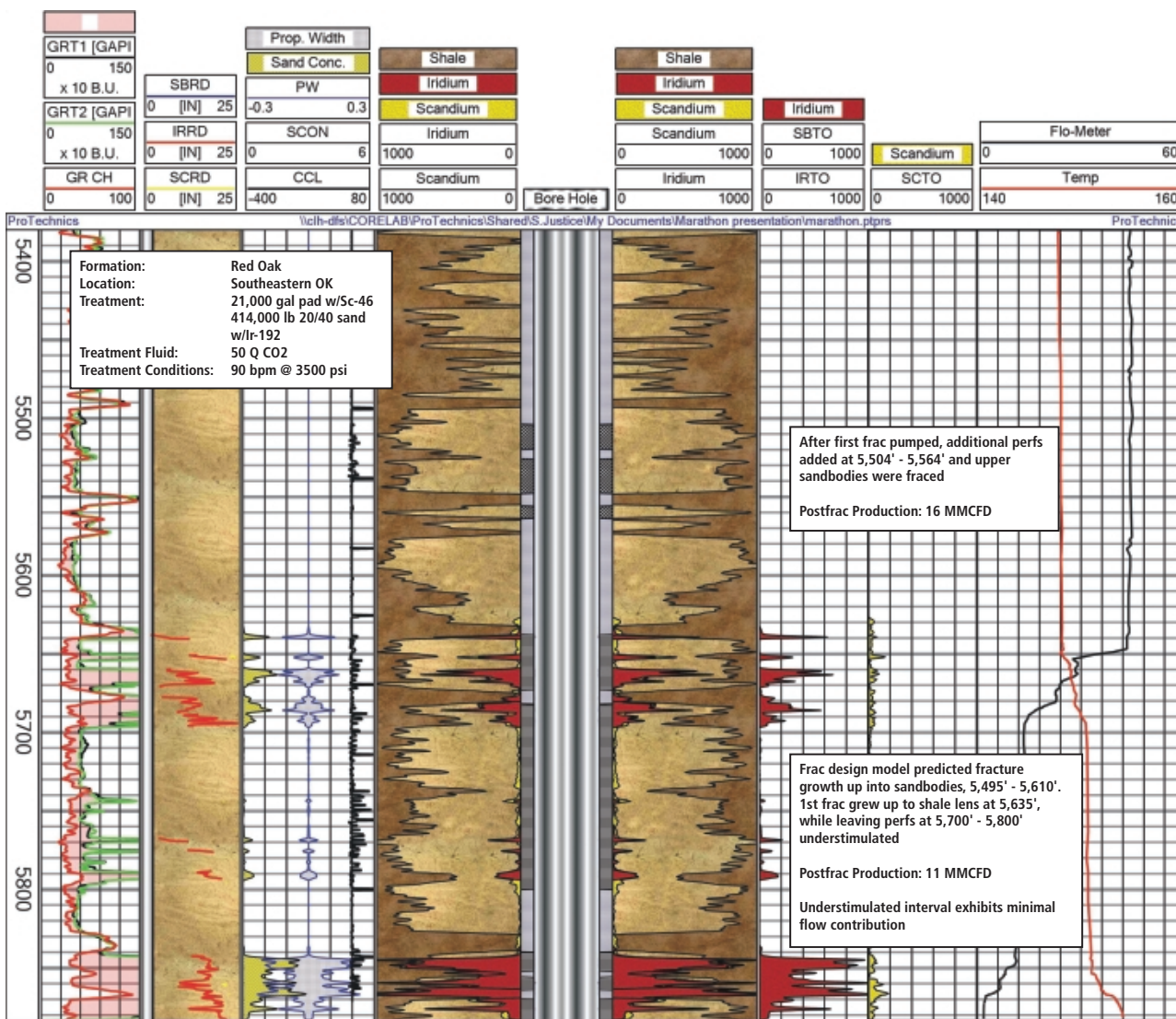
Completion Profiler™ – Full service production evaluation image; spinner, pressure/temperature, nuclear density and electrical capacitance

Other Services

Stim-Lab – Laboratory services for reservoir fluid compatibility testing, regained permeability testing, fluid performance testing at fracture conditions

PROMORE – ERD sensor technology for permanent downhole pressure and temperature gauging systems

GOHFER® – 3D fracture simulator



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